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development, Orchideæ, Liliaceæ, Palmæ and Gramineæ, say that one was descended from or even directly connected with the others? It would be a violation of all principles of classification, and a libel on common sense. But when we take each order and show how, through this genus or that one, it is directly or remotely connected with some other one, then we feel a little confidence in saying we are approaching a natural classification. None of our systems can be entirely natural at present. We do not know, as yet, the characters and affinities of all the plants in the world, and until we do know that we cannot hope for anything but an approximation towards the correct idea of a perfectly natural arrangement of plants.

[*Note*.—This article was first read at a meeting of the Cincinnati Society of Natural History, and the first portion of it, viz., that relating to the Compositæ, was afterwards read at the Minneapolis meeting of the Am. Assoc. for the Adv. of Science.]

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ON THE HABITS OF CERTAIN SUNFISH.

BY C. C. ABBOTT, M.D.

ALTHOUGH the two small centrarchoids, *Mesogonistius chætodon*, or banded sunfish, and *Enneacanthus simulans*, or spotted sunfish, have been long known to ichthyologists, almost nothing has been recorded of their habits.

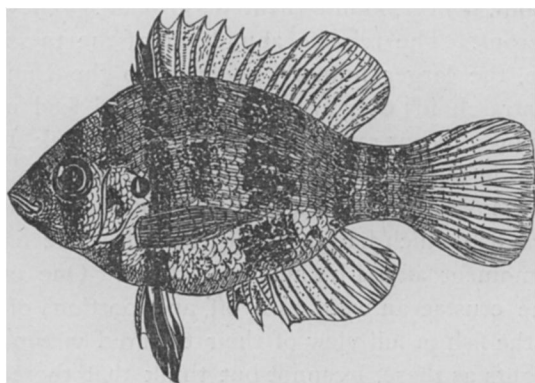
In those of our shallow, sluggish waters, which have an indefinitely deep, muddy bottom, and harbor a rank growth of aquatic vegetation, the handsome, silvery, black-banded sunfish is a common species. In such localities, where often the weeds grow so luxuriantly that a scoop-net cannot be drawn, I have found that hundreds of these fishes were passing what I think must be a most monotonous existence. In some places locomotion must be rather a scramble among the water weeds, than a comfortable swim. Still, these spots have their advantages, for among these plants are to be found myriads of insect larvæ and other small fry that constitute a never-failing supply of food.

As a fish for the aquarium the banded sunfishes are deservedly popular, and indeed, they are better known as dwellers in such narrow quarters than as a prominent species in the fauna of the Lower Delaware valley. I believe they are not found above tide water at all. I have frequently shown these fish to old fishermen

who rarely acknowledge that they have ever before seen them; and this fact is corroborative of what I had long supposed, that they are only to be found in out-of-the-way nooks and corners where game fish seldom if ever come, and that hence their haunts are not often invaded. In fact, one would scarcely expect to find any fish in some of the weed-grown holes in the meadows, where in truth scores of banded sunfish are quietly taking their ease.

Occasionally, however, I have seen this fish wander into quite open waters, and here it is that it shows to such advantage when, with its brilliant black dorsal and ventral fins spread, it moves majestically along.

Although so small, it is a plucky fish, and promptly resents any interference. Being a feeble swimmer, it depends, for defense, upon the sharp spines of its dorsal fin, and it seems to know that



Banded Sunfish (*Mesogonistius chatodon*).

when these are erected it is quite free from molestation. Especially angry does it become when a great lubberly catfish chances to wander near by and pokes his slimy nose into its haunts. At once the "bandy" is up in arms, and darts at the intruder with great violence. It is a veritable case of the king-bird and the crow over again, only beneath the water instead of in the air.

I am still in the dark about the breeding habits of this fish. At times I have thought that it scooped out a nest in the sand, as the common sunfish (*Lepomis gibbosus*) does, but I am not so sure about it. During the spring of 1881 I found females of this species heavy with immature ova, and I am now of the opinion that if any nest is made it is in comparatively deep water, among the lily stems, or at the base of some projecting root. Certainly if

anywhere in open water I should have found them before this. A puzzling fact that haunted me whenever I went fishing, until very recently (September, 1883), was, that I never found any very young "bandies," as I usually call them. I had often scooped up scores of the mud-loving *Enneacanthi*, found in the same quarters, but with never a "bandy" among them. Hoping ever for better things, I continued to search for them, and at last success crowned my efforts. Early in September last I found scores of little ones, some not more than half an inch in length. It is safe to say, therefore, that the ova are deposited in May or June. Just where, remains to be determined.

A very constant companion of the preceding, to which I have briefly referred as the spotted sunfish (*Enneacanthus simulans*) has, one would think, essentially the same habits as the banded fish. I have seldom, if ever, found them dissociated. They are even more numerous. The relative abundance of the two is about as two to five, the larger number referring to the *Enneacanthus*. Like all centrarchoids they are carnivorous, and feed upon living prey. During a recent ramble along Watson's creek, I saw quite a commotion in the shallow water near shore, and on approaching the spot I discovered that three of these spotted sunfish had attacked a crayfish which had just cast its shell. The battle lasted but for a moment after I became a spectator. One by one the limbs of the crustacean were torn off, and portions of them devoured by the fish in full view of their tortured victim. When I see such sights as these, I cannot but think that there is a screw loose in nature—that nothing is perfect, and animal life is only reaching out towards perfection.

I have said that these two sunfish have apparently the same habits, but it is a case wherein appearances are misleading. Considering that they are so very dissimilar in color, and generically distinct, it recently occurred to me to determine, if possible, if there were not points of difference which I had overlooked. Gathering a large number of specimens from the same locality, I noticed that with a seine drawn over a considerable space, many of the two fishes were taken; but, when a scoop-net was used, if a cluster of spatter docks (*Nuphar luteum*, var. *pumilum*) was covered, I ordinarily captured specimens of the banded sunfish, and the spotted sunfish were taken from masses of *Myriophyllum* of different species. This was not invariably the case,

but so generally that I concluded that the growths of *Nuphar luteum* and similar plants were the favorite haunts of the banded sunfish, and the muddy masses of *Myriophyllum* harbored the spotted species.

On submitting the specimens to Dr. A. C. Stokes, of Trenton, N. J., he kindly examined the contents of the stomachs of these species by the aid of the microscope, with the following results:

In the stomachs of a dozen or more adult banded sunfish he found *Chironomus* larvæ very numerous; *Cyclops quadricornis* numerous; *Daphnia* sp. numerous; chitinous parts of small insects present but not abundant; diatoms, desmids and fragments of algæ, probably accidental; and a single rhizopod (*Centropyxis aculeata*). In very young fish he found *Chironomus* larvæ few, and *Cyclops quadricornis* and *Daphnia* sp. numerous.

He adds, "In the stomach of a full-grown fish there was from seventy-five to one hundred *Chironomus* larvæ, which seem to be the favorite food." This shows at a glance that the banded sunfish is essentially a surface feeder, and as we seldom see them moving about in the open water or near the surface, they are probably nocturnal in their habits. In an aquarium, however, they seem to be as active during the day, as at night, although averse to exposure to direct sunlight.

The examination of twelve adult specimens of spotted sunfish, resulted as follows:

In every case the stomach was empty, but the intestine contained tracheæ, eyes, elytra, heads and chitinous parts of small aquatic beetles. These were very numerous; also *Pisidium* sp. occasional; several small univalve mollusks; a few *Chironomus* larvæ; occasionally a *Daphnia* and *Cyclops*; and *Gammarus* sp. numerous. In the very young spotted sunfish examined, there were found *Pisidium* sp. occasionally; many *Daphnia* and *Chironomus* larvæ; a few fragments of insects; many *Cyclops*; a few very small univalve mollusks, and a single water mite.

Here we have evidence that this species of sunfish is a bottom feeder, and resorts to the mud rather than elsewhere for its main food supply.

I have already mentioned the great difference in the coloration of these two sunfish, which are, as we have seen, quite intimately associated. Whether this difference has any direct relation to their widely different feeding habits, I will not now essay to determine.